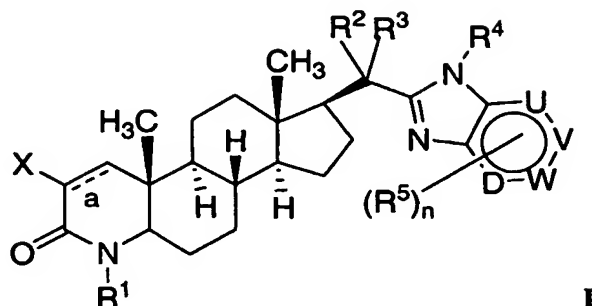


WHAT IS CLAIMED IS:

1. A compound of structural formula I:



a pharmaceutically acceptable salt or a stereoisomer thereof,

wherein:

a is chosen from a double bond and a single bond;

X is hydrogen or halogen;

n is 0, 1, 2, 3, or 4;

U, V, W, and D are each independently chosen from CH, and N, provided that at least one of U, V, W, and D is CH;

R¹ is chosen from hydrogen, CF₃, carbonyl(C₁₋₃ alkyl), hydroxyl, C₁₋₄ alkoxy, halogen, C₁₋₃ alkyl, hydroxymethyl, and (C₀₋₆ alkyl)₂amino, wherein said alkyl and alkoxy are each optionally substituted with one to seven fluorine atoms;

R² and R³ are each independently chosen from: hydrogen, halogen, C₁₋₈ alkyl, amino C₀₋₆alkyl, C₁₋₆ alkylamino C₀₋₆alkyl, (C₁₋₆ alkyl)₂amino C₀₋₆alkyl, C₁₋₆ alkoxy C₀₋₆alkyl, hydroxycarbonyl C₀₋₆alkyl, hydroxy C₀₋₆alkyl, C₁₋₆ alkoxy carbonyl C₀₋₆alkyl, hydroxycarbonyl C₁₋₆ alkyloxy, cyano, perfluoroC₁₋₄alkyl, perfluoroC₁₋₄alkoxy, C₀₋₆ alkylcarbonyl, C₁₋₆ alkylcarbonyloxy, C₁₋₆ alkylcarbonylamino, C₁₋₆ alkylsulfonylamino, C₁₋₆ alkoxy carbonylamino, C₁₋₆ alkylaminocarbonylamino, (C₁₋₆alkyl)₂ aminocarbonylamino, and (C₁₋₆alkyl)₂ aminocarbonyloxy,

and wherein

R² and R³ together with the carbon atom to which they are attached can optionally form a C₃₋₆ cycloalkyl group, or an oxo group, and

R² and R³ are each independently optionally substituted with one or more R⁶;

R⁴ is chosen from: hydrogen, halogen, C₁₋₁₀ alkyl(carbonyl)₀₋₁, aryl C₀₋₈ alkyl, amino C₀₋₈ alkyl, C₁₋₃ acylamino C₀₋₈ alkyl, C₁₋₆ alkylamino C₀₋₈ alkyl, C₁₋₆ dialkylamino C₀₋₈ alkyl, aryl C₀₋₆ alkylamino C₀₋₆ alkyl, C₁₋₄ alkoxyamino C₀₋₈ alkyl, hydroxy C₁₋₆ alkylamino C₀₋₈ alkyl, C₁₋₄ alkoxy C₀₋₆ alkyl, hydroxycarbonyl C₀₋₆ alkyl, C₁₋₄ alkoxycarbonyl C₀₋₆ alkyl, hydroxycarbonyl C₀₋₆ alkyloxy, hydroxy C₁₋₆ alkylamino C₀₋₆ alkyl, or hydroxy C₀₋₆ alkyl,

wherein R⁴ is optionally substituted with one or more groups chosen from hydrogen, OH, (C₁₋₆)alkoxy, halogen, CO₂H, CN, O(C=O)C₁₋₆ alkyl, NO₂, trifluoromethoxy, trifluoroethoxy, -O(₀₋₁)(C₁₋₁₀)perfluoroalkyl, and NH₂;

R⁵ is chosen from: halogen, (carbonyl)₀₋₁C₁₋₁₀ alkyl, (carbonyl)₀₋₁C₂₋₁₀ alkenyl, (carbonyl)₀₋₁C₂₋₁₀ alkynyl, (carbonyl)₀₋₁aryl C₁₋₁₀ alkyl, C₃₋₈ cycloalkyl C₀₋₁₀ alkyl, (C₃₋₈)heterocyclyl C₀₋₁₀ alkyl, C₁₋₄acylamino C₀₋₁₀ alkyl, C₀₋₁₀ alkylamino C₀₋₁₀ alkyl, di-(C₁₋₁₀ alkyl)amino C₀₋₁₀ alkyl, arylC₀₋₁₀ alkylamino C₀₋₁₀ alkyl, (arylC₀₋₁₀ alkyl)₂amino C₀₋₁₀ alkyl, C₃₋₈ cycloalkyl C₀₋₁₀ alkylamino C₀₋₁₀ alkyl, C₃₋₈ heterocyclyl C₀₋₁₀ alkylamino C₀₋₁₀ alkyl, (C₃₋₈ cycloalkyl C₀₋₁₀ alkyl)₂amino C₀₋₁₀ alkyl, (C₃₋₈ heterocyclyl C₀₋₁₀ alkyl)₂amino C₀₋₁₀ alkyl, C₃₋₈ cycloalkyl C₀₋₁₀ alkyl aminocarbonylamino, (C₁₋₁₀ alkyl)₂aminocarbonylamino, (aryl C₁₋₁₀ alkyl)₁₋₂aminocarbonylamino, C₀₋₁₀ alkyl aminocarbonylamino, C₃₋₈ heterocyclyl C₀₋₁₀ alkyl aminocarbonylamino, (C₁₋₁₀ alkyl)₂aminocarbonyl C₀₋₁₀ alkyl, (aryl C₁₋₁₀ alkyl)₁₋₂aminocarbonyl C₀₋₁₀ alkyl, C₀₋₁₀ alkyl aminocarbonyl C₀₋₁₀ alkyl, C₃₋₈ cycloalkyl C₀₋₁₀ alkyl aminocarbonyl C₀₋₁₀ alkyl, C₃₋₈ heterocyclyl C₀₋₁₀ alkyl aminocarbonyl C₀₋₁₀ alkyl, aryl C₀₋₁₀ alkyl aminocarbonyl C₀₋₁₀ alkyl,

(C₁₋₁₀ alkyl)₂aminocarbonyl, (aryl C₁₋₁₀ alkyl)₁₋₂aminocarbonyl,
 C₁₋₁₀ alkoxy (carbonyl)₀₋₁C₀₋₁₀ alkyl, carboxy C₀₋₁₀ alkylamino,
 carboxy C₀₋₁₀ alkyl, carboxy aryl, carboxy C₃₋₈ cycloalkyl,
 carboxy C₃₋₈ heterocyclyl, C₁₋₁₀ alkoxy, C₁₋₁₀alkyloxy C₀₋₁₀alkyl
 5 C₁₋₁₀ alkylcarbonyloxy, C₃₋₈ heterocyclyl C₀₋₁₀ alkylcarbonyloxy,
 C₃₋₈ cycloalkyl C₀₋₁₀ alkylcarbonyloxy, aryl C₀₋₁₀ alkylcarbonyloxy,
 C₁₋₁₀ alkylcarbonyloxy amino, aryl C₀₋₁₀ alkylcarbonyloxy amino,
 C₃₋₈ heterocyclyl C₀₋₁₀ alkylcarbonyloxy amino,
 C₃₋₈ cycloalkyl C₀₋₁₀ alkylcarbonyloxy amino,
 10 (C₁₋₁₀ alkyl)₂aminocarbonyloxy, (aryl C₀₋₁₀ alkyl)₁₋₂aminocarbonyloxy,
 (C₃₋₈ heterocyclyl C₀₋₁₀ alkyl)₁₋₂aminocarbonyloxy,
 (C₃₋₈ cycloalkyl C₀₋₁₀alkyl)₁₋₂aminocarbonyloxy,
 hydroxy C₀₋₁₀alkyl, hydroxycarbonylC₀₋₁₀alkoxy,
 hydroxycarbonylC₀₋₁₀alkyloxy, C₁₋₁₀ alkylthio, C₁₋₁₀ alkylsulfinyl,
 15 aryl C₀₋₁₀ alkylsulfinyl, C₃₋₈ heterocyclyl C₀₋₁₀ alkylsulfinyl,
 C₃₋₈ cycloalkyl C₀₋₁₀ alkylsulfinyl, C₁₋₁₀ alkylsulfonyl,
 aryl C₀₋₁₀ alkylsulfonyl, C₃₋₈ heterocyclyl C₀₋₁₀ alkylsulfonyl,
 C₃₋₈ cycloalkyl C₀₋₁₀ alkylsulfonyl, C₁₋₁₀ alkylsulfonylamino,
 aryl C₁₋₁₀ alkylsulfonylamino, C₃₋₈ heterocyclyl C₁₋₁₀ alkylsulfonylamino,
 20 C₃₋₈ cycloalkyl C₁₋₁₀ alkylsulfonylamino, cyano, nitro, perfluoroC₁₋₆alkyl, and
 perfluoroC₁₋₆alkoxy;

wherein R⁵ is optionally substituted with at least one substituent, R⁶; and

R⁶ is chosen from: halogen, (carbonyl)₀₋₁C₁₋₁₀ alkyl, (carbonyl)₀₋₁C₂₋₁₀ alkenyl,

(carbonyl)₀₋₁C₂₋₁₀ alkynyl, (carbonyl)₀₋₁aryl C₀₋₁₀ alkyl,
 25 C₃₋₈ cycloalkyl C₀₋₁₀ alkyl, (C₃₋₈)heterocyclyl C₀₋₁₀ alkyl,
 (C₃₋₈)heterocycloalkyl C₀₋₁₀ alkyl, C₁₋₄acylamino C₀₋₁₀ alkyl,
 C₀₋₁₀ alkylamino C₀₋₁₀ alkyl, di-(C₁₋₁₀ alkyl)amino C₀₋₁₀ alkyl,
 arylC₀₋₁₀ alkylamino C₀₋₁₀ alkyl, (arylC₀₋₁₀ alkyl)₂amino C₀₋₁₀ alkyl,
 C₃₋₈ cycloalkyl C₀₋₁₀ alkylamino C₀₋₁₀ alkyl,
 30 C₃₋₈ heterocyclyl C₀₋₁₀ alkylamino C₀₋₁₀ alkyl,
 C₃₋₈ heterocycloalkyl C₀₋₁₀ alkylamino C₀₋₁₀ alkyl,

C₀₋₁₀ alkyl carbimidoyl C₀₋₁₀ alkyl, (C₁₋₁₀ alkyl)₂aminocarbonyl,
 C₁₋₁₀ alkoxy (carbonyl)₀₋₁ C₀₋₁₀ alkyl, C₁₋₁₀ alkyloxy C₀₋₁₀ alkyl,
 (C₁₋₁₀ alkyl)₂aminocarbonyloxy, hydroxycarbonyl C₀₋₁₀ alkoxy,
 (C₁₋₁₀ alkyl)₂aminocarbonyloxy, (aryl C₀₋₁₀ alkyl)₁₋₂aminocarbonyloxy,
 5 hydroxy C₀₋₁₀ alkyl, C₁₋₁₀ alkylsulfonyl, C₁₋₁₀ alkylsulfonylamino,
 aryl C₁₋₁₀ alkylsulfonylamino, C₃₋₈ heterocyclyl C₁₋₁₀ alkylsulfonylamino,
 C₃₋₈ heterocycloalkyl C₁₋₁₀ alkylsulfonylamino, perfluoro C₁₋₆ alkoxy,
 C₃₋₈ cycloalkyl C₁₋₁₀ alkylsulfonylamino, cyano, nitro, and perfluoro C₁₋₆ alkyl,

wherein R⁶ is optionally substituted with one or more groups chosen from: OH, NO₂, (C₁₋₆)alkoxy,
 10 halogen, CO₂H, CN, O(C=O)C_{1-C6} alkyl, trifluoromethoxy, trifluoroethoxy, and -O(0-1)(C₁₋₁₀)perfluoroalkyl.

2. A compound according to Claim 1, wherein X is fluorine.

15 3. A compound according to Claim 1, wherein X is hydrogen.

4. A compound according to Claim 1, wherein R¹ is chosen from: hydrogen, CF₃,
 hydroxyl, and C₁₋₃ alkyl optionally substituted with one to seven fluorine atoms.

20 5. A compound according to Claim 4, wherein R¹ is chosen from: hydrogen and
 C₁₋₃ alkyl.

6. A compound according to Claim 5, wherein R¹ is methyl.

25 7. A compound according to Claim 6, wherein U, V, W, and D are each
 independently chosen from CH and N, provided that at least two of U, V, W, and D are each CH.

8. A compound according to Claim 7, wherein R⁵ is chosen from: halogen,
 (carbonyl)₀₋₁ C₁₋₁₀ alkyl, (carbonyl)₀₋₁ C₂₋₁₀ alkenyl,
 30 (carbonyl)₀₋₁ C₂₋₁₀ alkynyl, C₁₋₁₀ alkenylamino, (carbonyl)₀₋₁ aryl C₀₋₁₀ alkyl,
 C₃₋₈ cycloalkyl C₀₋₁₀ alkyl, (C₃₋₈)heterocyclyl C₀₋₁₀ alkyl,
 C₃₋₈ heterocycloalkyl C₀₋₁₀ alkyl, C₁₋₄ acylamino C₀₋₁₀ alkyl,

) C₃₋₈heterocycloalkylC₀₋₁₀alkyl(carbonyl)0-1oxyC₀₋₁₀alkylamino,
C₃₋₈cycloalkylC₀₋₁₀alkyl(carbonyl)0-1oxyC₀₋₁₀alkylamino,

aryl C₀₋₁₀ alkyl(carbonyl)₀₋₁oxyC₀₋₁₀ alkylamino,
C₁₋₁₀ alkylsulfonylamino, aryl C₁₋₁₀ alkylsulfonylamino,
C₃₋₈ heterocyclyl C₁₋₁₀ alkylsulfonylamino,
C₃₋₈ heterocycloalkyl C₁₋₁₀ alkylsulfonylamino,

- 5 C₃₋₈ cycloalkyl C₁₋₁₀ alkylsulfonylamino, cyano, nitro,
perfluoroC₁₋₆alkyl, and perfluoroC₁₋₆alkoxy, and
wherein R⁵ is optionally substituted with at least one substituent R⁶.

9. A compound according to Claim 8, wherein R² and R³ are each independently
10 chosen from: hydrogen, halogen, C₁₋₈ alkyl, amino C₀₋₆alkyl,
C₁₋₆ alkylamino C₀₋₆alkyl, C₁₋₆ alkoxy C₀₋₆alkyl, hydroxycarbonyl C₀₋₆alkyl, hydroxycarbonyl C₁₋₆
alkyloxy, hydroxy C₀₋₆alkyl, C₀₋₆ alkylcarbonyl,
C₁₋₆ alkylcarbonyloxy, C₁₋₆ alkylcarbonylamino, C₁₋₆ alkoxycarbonylamino,
C₁₋₆alkylaminocarbonylamino, and wherein
15 R² and R³ together with the carbon atom to which they are attached can optionally form a C₃₋₆ cycloalkyl
group, or an oxo group, and
R² and R³ are each independently optionally substituted with one or more R⁶.

- 20 10. A compound according to Claim 9, wherein X is hydrogen.

11. A compound according to Claim 9, wherein X is fluorine.

12. A compound according to Claim 10, wherein at least two of U, V, W, and D are
each CH.

- 25 13. A compound according to Claim 10, wherein U, V, W and D are each CH.

14. A compound according to Claim 3, wherein a is a double bond.

- 30 15. A compound according to Claim 1, selected from:
and pharmaceutically acceptable salts and stereoisomers thereof.

16. A method for modulating a function mediated by the androgen receptor in a mammal in need of such modulation comprising administering a therapeutically effective amount of a compound of Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

5 17. A method of activating the function of the androgen receptor in a mammal in need of such activation comprising administering a therapeutically effective amount of a compound of Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

10 18. A method of Claim 16, wherein said function mediated by the androgen receptor is activated in bone or muscle tissue and blocked in the prostate or the uterus.

15 19. A method of treating a condition in a mammal which is caused by androgen deficiency, which can be ameliorated by androgen replacement, or which can be increased by androgen replacement, which condition is selected from weakened muscle tone, osteoporosis, osteopenia, glucocorticoid-induced osteoporosis, periodontal disease, bone fracture, bone damage following bone reconstructive surgery, sarcopenia, frailty, aging skin, male hypogonadism, postmenopausal symptoms in women, atherosclerosis, hypercholesterolemia, hyperlipidemia, obesity, aplastic anemia, hematopoietic disorders, arthritic condition and joint repair, HIV-wasting, prostate cancer, cancer cachexia, muscular dystrophies, Alzheimer's disease, cognitive decline, sexual dysfunction, sleep apnea, benign prostate hyperplasia, abdominal adiposity, metabolic syndrome, type II diabetes, depression, premature ovarian failure, and autoimmune disease comprising administering to the mammal in need of such treatment, a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

25 20. A method according to Claim 19, wherein said condition is osteoporosis.

21. A method of treating osteoporosis in a mammal in need thereof, comprising administering a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

30 22. A method of Claim 21, further comprising the administration of an agent selected from:

- 1) an estrogen or an estrogen derivative, alone or in combination with a progestin or progestin derivative,

- 2) a bisphosphonate,
- 3) an antiestrogen or a selective estrogen receptor modulator,
- 4) an $\alpha_v\beta_3$ integrin receptor antagonist,
- 5) a cathepsin K inhibitor,
- 5 6) an HMG-CoA reductase inhibitor,
- 7) an osteoclast vacuolar ATPase inhibitor,
- 8) an antagonist of VEGF binding to osteoclast receptors,
- 9) an activator of peroxisome proliferator-activated receptor γ ,
- 10) calcitonin,
- 10 11) a calcium receptor antagonist,
- 12) parathyroid hormone or analog thereof,
- 13) a growth hormone secretagogue,
- 14) human growth hormone,
- 15) insulin-like growth factor,
- 15 16) a p38 protein kinase inhibitor,
- 17) bone morphogenetic protein,
- 18) an inhibitor of BMP antagonism,
- 19) a prostaglandin derivative,
- 20) vitamin D or vitamin D derivative,
- 20 21) vitamin K or vitamin K derivative,
- 22) ipriflavone,
- 23) fluoride salts,
- 24) dietary calcium supplement, and
- 25) osteoprotegerin.

25 23. The method according to Claim 22, wherein:

- 1) the estrogen or estrogen derivative, alone or in combination with a progestin or progestin derivative, is selected from conjugated estrogen, equine estrogen, 17β -estradiol, estrone, 17β -ethynyl estradiol, 17β -ethynyl estradiol with at least one agent selected from
30 norethindrone and medroxyprogesterone acetate;
- 2) the bisphosphonate is selected from alendronate, clodronate, etidronate, ibandronate, incadronate, minodronate, neridronate, olpadronate, pamidronate, piridronate, risedronate, tiludronate, and zoledronate;

- 3) the antiestrogen or selective estrogen receptor modulator is selected from raloxifene, clomiphene, zuclomiphene, enclomiphene, nafoxidene, CI-680, CI-628, CN-55,945-27, Mer-25, U-11,555A, U-100A, tamoxifen, lasofoxifene, toremifene, azorxifene, EM-800, EM-652, TSE 424, droloxifene, idoxifene, and levormeloxifene;
- 5 4) the HMG-CoA reductase inhibitor is selected from lovastatin, simvastatin, dihydroxy-open acid simvastatin, pravastatin, fluvastatin, atorvastatin, cerivastatin, rosuvastatin, pitavastatin, and nisvastatin;
- 5) calcitonin is salmon calcitonin administered as a nasal spray;
- 6) bone morphogenetic protein is selected from BMP 2, BMP 3, BMP 5, BMP 6, BMP 7, TGF
10 beta, and GDF5;
- 7) insulin-like growth factor is selected from IGF I and IGF II alone or in combination with IGF binding protein 3;
- 8) the prostaglandin derivative is selected from agonists of prostaglandin receptors EP₁, EP₂, EP₄, FP, and IP;
- 9) the fibroblast growth factor is selected from aFGF and bFGF;
- 10) parathyroid hormone (PTH) or PTH analog is selected from PTH subcutaneous injection, human PTH (1-84), human PTH (1-34), and other partial sequences, native or with substitutions;
- 11) vitamin D or vitamin D derivative is selected from natural vitamin D, 25-OH-vitamin D₃,
20 1 α ,25(OH)₂ vitamin D₃, 1 α -OH-vitamin D₃, 1 α -OH-vitamin D₂, dihydrotachysterol, 26,27-F₆-1 α ,25(OH)₂ vitamin D₃, 19-nor-1 α ,25(OH)₂vitamin D₃, 22-oxacalcitriol, calcipotriol, 1 α ,25(OH)₂-16-ene-23-yne-vitamin D₃(Ro 23-7553), EB1089, 20-epi-1 α ,25(OH)₂ vitamin D₃, KH1060, ED71, 1 α ,24(S)-(OH)₂ vitamin D₃, and 1 α ,24(R)-(OH)₂ vitamin D₃;
- 12) the dietary calcium supplement is selected from calcium carbonate, calciumcitrate, and natural calcium salts; and
- 13) the fluoride salts are chosen from sodium fluoride and monosodium fluorophosphate (MFP); and pharmaceutically acceptable salts or stereoisomers thereof.
24. The method according to Claim 23, wherein the bisphosphonate is alendronate monosodium trihydrate or alendronate monosodium monohydrate.

25. The method of Claim 22, wherein said agent is selected from:

an estrogen or an estrogen derivative, alone or in combination with a progestin or progestin derivative, a bisphosphonate, an antiestrogen or a selective estrogen receptor modulator, an $\alpha\text{v}\beta 3$ integrin receptor antagonist, a cathepsin K inhibitor,
5 an osteoclast vacuolar ATPase inhibitor, calcitonin, osteoprotegrin, and parathyroid hormone or analog thereof.

26. A pharmaceutical composition comprising a therapeutically effective amount of a compound of Claim 1 and a pharmaceutically acceptable carrier.

10 27. A composition of Claim 26, further comprising an active ingredient selected from: an estrogen or an estrogen derivative, alone or in combination with a progestin or progestin derivative, a bisphosphonate, an antiestrogen or a selective estrogen receptor modulator, an $\alpha\text{v}\beta 3$ integrin receptor antagonist, a cathepsin K inhibitor, an HMG-CoA reductase inhibitor, an osteoclast
15 vacuolar ATPase inhibitor, an antagonist of VEGF binding to osteoclast receptors, an activator of peroxisome proliferator-activated receptor γ , calcitonin, a calcium receptor antagonist, parathyroid hormone or analog thereof, a growth hormone secretagogue, human growth hormone, insulin-like growth factor, a p38 protein kinase inhibitor, bone morphogenetic protein, an inhibitor of BMP antagonism, a
20 prostaglandin derivative, vitamin D or vitamin D derivative, vitamin K or vitamin K derivative, ipriflavone, fluoride salts, dietary calcium supplements, and osteoprotegerin.

28. A composition of Claim 27, wherein said bisphosphonate is alendronate.

25 29. A method of inhibiting bone resorption in a mammal in need thereof, comprising administering a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

30 30. A method of increasing Bone Mineral Density in a mammal in need thereof, comprising administering a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

31. A method of reducing the risk of vertebral or non-vertebral fractures in a mammal in need thereof, comprising administering a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

32. A method of effecting a bone turnover marker in a mammal in need thereof, comprising administering a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof, wherein said bone turnover marker is selected from urinary C-telopeptide degradation products of type I collagen (CTX), urinary N-telopeptide cross-links of type I collagen (NTX), DXA, and DPD.

33. A pharmaceutical composition made by combining a compound according to Claim 1 and a pharmaceutically acceptable carrier.

34. A process for making a pharmaceutical composition comprising combining a compound according to Claim 1 and a pharmaceutically acceptable carrier.

35. A method of treating or preventing an arthritic condition in a mammal in need thereof, comprising administering a therapeutically effective amount of a compound according to Claim 1 or a pharmaceutically acceptable salt or a stereoisomer thereof.

36. A method of Claim 35, wherein the arthritic condition is selected from rheumatoid arthritis and osteoarthritis.